Compton Backscatter Tomography

High-resolution tomography on objects with access to a single side: a new method

LLNL is developing a technique to obtain three-dimensional images of objects that would be impossible to image using standard radiographic or tomographic methods. Standard methods rely on the attenuation of an x-ray beam as it passes through an object and is recorded in the detector. The detector and x-ray source must be located on opposite sides of the object being radiographed. To overcome this limitation, our technique images objects using scattered radiation. Our one-sided inspection technique also includes the determination of subsurface structures and voids.

APPLICATIONS

- *Detection of cracks, voids, and inclusions in composite materials*
- *Medical imaging of body tissue*
- *Routine examination of artillery shells*
- *Inspection of off-shore structures*
- *Inspection of concrete for steel rebar and void enclosures*
- *Inspection of aircraft, automobile, and nuclear power industry components*

Conventional techniques and their limitations

Conventional scattering techniques require high collimation on the incident beam, the detector, or both. This collimation is necessary because conventional scattering tomography consists of rastering the intersection of the beam and detector viewing cone throughout the entire volume being investigated—an extremely time-consuming process.

Imaging objects accessible from only one side

LLNL has developed a technique that uses the above principle—a highly collimated beam and measurement of the Compton energy shift—but does not require a small detector. Our detector and therefore our efficiency is several hundred times larger than that used in the prior state of the art. A second method, called "virtual collimation," will allow an additional improvement in efficiency of several hundred times.

We can optimize an imaging device for a particular application using our extensive experimental facilities and our highly accurate first-principles computational physics simulation facility. Thus, we will be able to predict the performance of any instrument in any arbitary industrial environment.

Availability: We are seeking university or industrial partners to collaborate in developing and further improving this technology. In particular, we seek collaborators with expertise in the design and fabrication of commercial gamma-ray spectrometry systems, the associated electronics, and software.

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